1. Place the fiber used on the optical bench in the injection device equipped with an X10 lens at the inlet.
2. Maximize injection with the adjustable holder:
   - or by using the Hewlett Packard radiometer as an output,
   - or by viewing the output on a screen.

   You should obtain at least ~~650μW~~ to continue the experiments.

600 - 700 μW → 640 μW

5.4.2 Speckles

Observe on a screen the speckles and energy distribution at the output of the 50/125 μm fiber. Explain this phenomenon.

Ref	5	10	15
640	625-630	635	640

5.4.3 Curvature

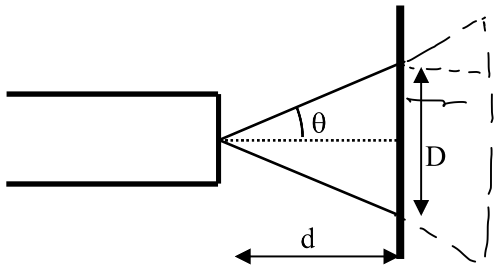
1. Visualize the effect of a curvature on the fiber
2. Measure and plot the evolution of the transmitted power for 5 radii of curvature: 5, 10, 15, 20, 25 mm.

∅ : 660

Radii	5	10	15	20	25
P(μW)	650				

5.4.4 Numerical Aperture

Make an approximate measurement of the numerical aperture using the following method:



$D_1 = 5cm$

$d_1 \simeq 12cm$

$d_2 \simeq 28cm$

$D_2 \simeq 12cm$

$O.N. = \sin\theta$

$\sin\theta \approx \frac{D}{2d}$

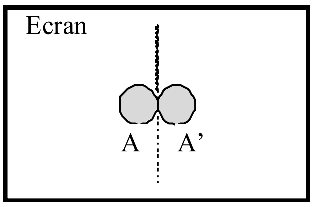
$\sin\left(\frac{12}{56}\right) = 0.21$

$\sin\left(\frac{5}{24}\right) \simeq 0,2068$

5.4.5 Core radius

Estimate the core radius of the fiber using the following method:

1. Place a microscope lens (40x) at the fiber output so that a sharp image A of the fiber output face is formed on the screen (located about 25cm away). virtual
2. Move one of the micrometric plates of the fiber support to make the image tangent on either side of a fixed vertical line from A to A'. The displacement read on the micrometric stop of this plate corresponds to the diameter of the fiber.



$\left.\begin{matrix} 2,3\ mm \\ 2,36\ mm \end{matrix}\right\} \Rightarrow$ Diameter $\simeq 0,06\ mm = 60\ \mu m$

5.5 Connection between two multimode fibers

5.5.1 Measurement of insertion losses

1. Adjust to get maximum output power. Measure this power P_0 using the HP radiometer.

2. After placing the fiber outlet in the adjustable V-shaped holder without modifying the injection, align a second multimode fiber place on the second V-shaped holder.
3. Optimize the coupling between the 2 fibers and measure the power P at the output of the 2nd fiber.
4. Calculate the insertion loss due to the connection:

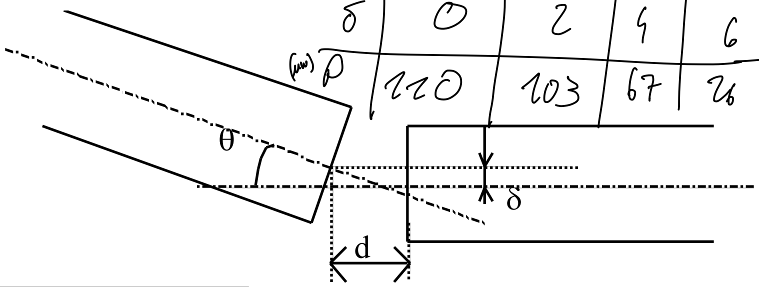
$$\alpha_c = -10.\log_{10}\left[\frac{P}{P_0}\right]$$

$\xrightarrow{2,36}$ 33

5.5.2 Determination of misalignment

	2,16	2,18	2,2	2,22	2,24	2,26	2,28	2,3	2,32	2,34
δ	0	2	4	6	8	10	12	14	16	18
(µW) P	110	103	67	26	9	2,1	0,9	600	390	160

$\underbrace{600 \quad 390 \quad 160}_{nW}$



1.1.1.1 Transverse misalignment

5.5.2.1 (δ)

1. Move the fiber transversely using the adjustable translation stage (20 µm between 2 divisions), noting the power corresponding to each movement.
2. After subtracting the connection loss (dB) determined above, plot the excess losses (dB) according to δ.
3. Trace: Excess losses (dB) = f (δ).

5.5.2.2 Longitudinal misalignment (d)

	8,24	8,04	7,84	7,64	7,44	7,24	7,04	6,84	6,64	6,44	6,24
d	0	1	2	3	4	5	6	7	8	9	10
P(µW)	160	114	91	68	49	34	29	26	16,5	15,2	11,8

1. Perform the same measurements for a longitudinal displacement of fiber.

For both misalignments compare your results with the theoretical ones in the annexes.

5.6 Measurement of the attenuation of a multimode fibre: cut-back method

When light is transmitted into an absorbent medium, attenuation occurs $\overline{\alpha}$ given by the relationship:

$$\overline{\alpha}(dB/km) = \frac{10}{z_2 - z_1} log_{10}\left[\frac{P(z_1)}{P(z_2)}\right]$$

$\overline{\alpha}$ depends on the wavelength.

1. **Use the coil of multimode fibre prepared for this measurement** present on table (remaining length and attenuation written on the coil).
2. Maximize the He-Ne/fiber laser coupling and measure the power output of the fiber with the HP radiometer. 340 µW → −4,64 dBm | −1,41 m → −4,54 dBm | −0,93 m → −4,52 dBm | −1,2 m −4,48 dBm | −0,95 m
3. Cut about 1 meter of fiber at the outlet **without touching the injection**. Indicate on the coil the new fibre length.
4. cleave the broken end of the fiber and measure the output power for this new length. Deduce the attenuation and compare it to the value on the coil.

Initial length ≈ 3,1 m

dBm (3,1) = −2,2

dBm (2,1) = −2,15

$$dBm = 10 \log\left(\frac{P}{1mW}\right)$$